FORTINET
High Performance Network Security

FortiOS VM OpenStack Cookbook

FortiOS 5.4

Change Log

Date	Change Description
January 18, 2017	Initial Release

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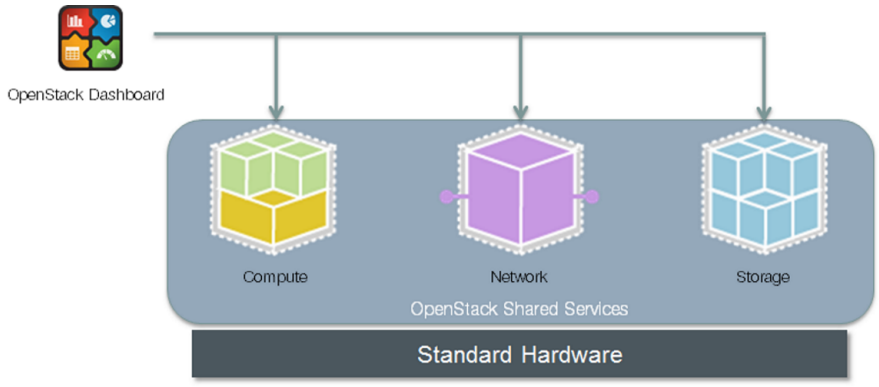
Getting Started

Components Overview

OpenStack is an open-source Cloud Management Platform, which controls a large pool of resources from single dashboard.



OpenStack components include:

Horizon Dashboard

- Graphical interface to access, provision and automate cloud-based resources
- Easy to plug in and expose third party products and services

Compute

- Compute engine to deploy and manage large number of VM instances to handle computing workload
- Architecture designed to scale horizontally on standard hardware

Networking

- Gives users real self service over their network configurations.
- Pluggable, scalable and API-driven system for managing networks and IP addresses

Storage

- Components used to store VM images and VM information

DevStack Single-node Installation

OpenStack provides a simple installation script for DevStack (the development stack). The intent is that OpenStack users and developers can easily and quickly install DevStack into a VM on a laptop.

The installation consists of the following steps:

- Preparation: Install Ubuntu OS
- Install DevStack

What's Next

After the installation, you can run the following examples on your OpenStack:

"Tenant Networks" on page 40 - create a tenant network

"FortiGate as Guest VM in OpenStack" on page 27 - create a FortiGate VM to control traffic between tenant VMs

Preparation

This example requires one VM running Ubuntu Linux and a FortiGate VM.

The following preparation steps are required:

1. Create a host VM for DevStack

If you are planning to instantiate a large number of VMs in your DevStack environment, make sure that you size the host VM or server appropriately. The following recommendations represent the minimum sizing numbers:

- Memory - 4 GB
- CPU - 1 vCPU
- Disk - 20-50 GB
- vNICs - 2

2. Install Ubuntu 14.04 on the VM

Install Ubuntu 14.04-2 LTS server as a VM on your laptop.

Log in to the console, and configure two interfaces (eth0 for public network, eth1 for private network):

```
auto eth0
iface eth0 inet static
address 172.16.2.135
netmask 255.255.255.0
gateway 172.16.2.2
dns-nameservers 8.8.8.8
auto eth1
iface eth1 inet manual
up ifconfig $IFACE 0.0.0.0 up
up ip link set $IFACE promisc on
down ip link set $IFACE promisc off
down ifconfig $IFACE 0.0.0.0 down
```

3. Install Git and OpenSSH.

As the root user, install Git and OpenSSH:

```
#sudo su
#apt-get update
#apt-get install git openssh-server
```

Install DevStack

The examples in this section assume the following Host VM port1 IP address:

Host VM: 172.16.2.135

To execute this set of instructions, log in as user “stack” . Unless otherwise specified, execute the commands on both nodes (controller and compute).

1. Create Devstack user

Create a user named **stack** with sudo privileges:

```
#groupadd stack
#useradd -g stack -s /bin/bash -d /opt/stack -m stack
#echo "stack ALL=(ALL) NOPASSWD: ALL" >> /etc/sudoer
#passwd stack
#exit
```

Switch to user **stack** for the remaining commands:

```
#su –l stack
```

2. Download the DevStack Software (stable Kilo version)

```
#git clone https://git.openstack.org/openstack-dev/devstack.git -b stable/kilo
#cd devstack
```

3. Create the local.conf file

Create the local.conf file. DevStack uses this configuration file when it starts up.

```
#vi local.conf
```

Enter insert mode. Cut and paste the following content:

```
[[local|localrc]]
PUBLIC_INTERFACE=eth1
ADMIN_PASSWORD=fortinet
MYSQL_PASSWORD=fortinet
RABBIT_PASSWORD=fortinet
SERVICE_PASSWORD=fortinet
SERVICE_TOKEN=fortinet

disable_service n-net
enable_service q-svc
enable_service q-agt
```

```
enable_service q-dhcp
enable_service q-l3
enable_service q-meta
enable_service n-cauth
enable_service neutron
enable_service q-vpn

FIXED_RANGE=10.0.0.0/24
FIXED_NETWORK_SIZE=256
NETWORK_GATEWAY=10.0.0.1
PRIVATE_SUBNET_NAME=privateA
PUBLIC_SUBNET_NAME=public-subnet
FLOATING_RANGE=172.16.125.0/24
PUBLIC_NETWORK_GATEWAY=172.16.125.2

Q_USE_DEBUG_COMMAND=True

[[post-config|/$Q_PLUGIN_CONF_FILE]]
[ml2]
extension_drivers = port_security
```

Enter :wq to save the file and quit the editor.

4. Take a Snapshot

We recommend that you take a snapshot of both VMs at this point. The snapshot provides a good recovery point in the event that the **stack.sh** script runs into problems.

5. Run stack.sh

Run “stack.sh” under ~stack/devstack.

A successful installation displays the following information at the end of the output. Note the IP address for the DevStack dashboard (Horizon), and the demo user password.:

```
.....
This is your host ip: 172.16.2.135
Horizon is now available at http://172.16.2.135/
Keystone is serving at http://172.16.2.135:5000/
The default users are: admin and demo
The password: fortinet
2015-07-07 09:13:34.429 | stack.sh completed in 464 seconds.
```

Display the Ubuntu routing table, to see the routes that DevStack created:

```
openstack@ubuntu:~/devstack$ ip route
default via 172.16.2.2 dev eth0
10.0.0.0/24 via 172.16.125.1 dev br-ex
169.254.0.0/16 dev eth0 scope link metric 1000
```

```
172.16.2.0/24 dev eth0 proto kernel scope link src 172.16.2.135
172.16.125.0/24 dev br-ex proto kernel scope link src 172.16.125.2
192.168.122.0/24 dev virbr0 proto kernel scope link src 192.168.122.1
```

6. Open the OpenStack Dashboard

You will be able to login to the OpenStack dashboard.

Navigate to https://<IP address of Controller node>

use ID: **admin** and password: **secretsecret** (the admin password that you set in local.conf)

The stack.sh script creates a demo project and one private network.

What's Next?

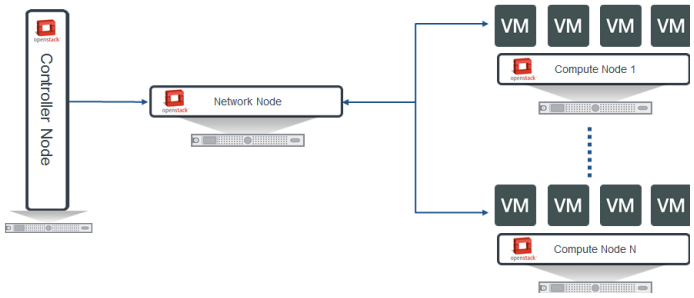
After the installation, you can run the following examples on your OpenStack:

"Tenant Networks" on page 40 - create a tenant network

"FortiGate as Guest VM in OpenStack" on page 27 - create a FortiGate VM to control traffic between tenant VMs

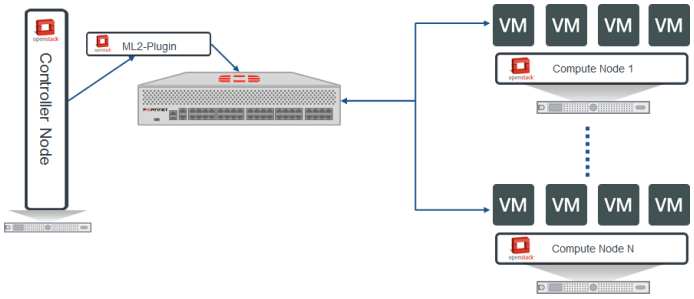
About the FortiGate ML2 Plugin

In the OpenStack architecture, L2 and L3 forwarding between compute nodes is provided by Neutron running in one or more network nodes.



In a large OpenStack deployment, the network node can become a bottleneck, as software-based forwarding is less efficient than hardware-based forwarding.

The FortiGate ML2 plugin enables a FortiGate device to provide the networking functionality in the OpenStack environment. The FortiGate provides L2, L3, DHCP and NAT functionality.



The OpenStack controller interacts with the FortiGate as the network node. When you add tenants and tenant networks through the OpenStack controller (using Horizon dashboard, the OS CLI, or API), the FGT ML2 plugin uses the FOS API to create/update the appropriate configurations on the FortiGate.

Initial FortiGate configuration:

After the ML2 plugin is deployed (ie. when you run the stack.sh script), the FortiGate is configured with two VDOMs:

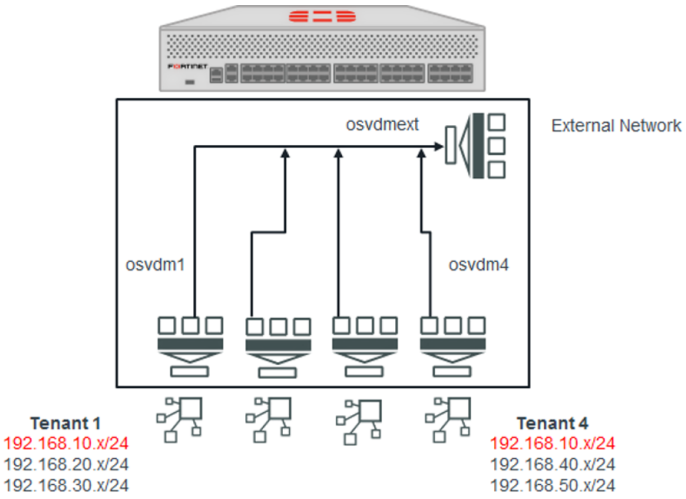
- “osvdmext”: to control connectivity with external network
- “osvdm1”: to inspect traffic for the “demo” tenant

Adding Tenants

When you add a new tenant, a new VDOM is created on the FortiGate. By using VDOMs, each tenant network is independent. Tenants can define private networks with overlapping IP addresses.

The system creates an Inter-VDOM link between the tenant VDOM and the EXT VDOM.

The created VDOMS are named osvdm{x}.



There is a limit of one router per tenant. The system creates a default static route and a default firewall on the FortiGate for the tenant.

If you associate a Floating IP address for the tenant, the ML2 plugin creates a virtual IP created in VDOM: root and VDOM: T1. An Ingress firewall policy is set to allow incoming traffic.

DevStack Multi-Node Installation with FGT ML2 Plugin

OpenStack provides a simple installation script for DevStack (the development stack). The intent is that OpenStack users and developers can easily and quickly install DevStack into a VM on a laptop.

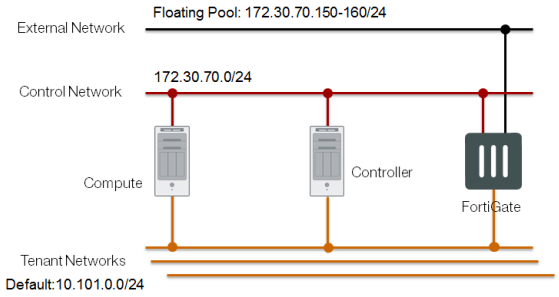
This example installs DevStack on two VM's (a controller node and a compute node), to create a simple multi-node OpenStack environment.

We also enable the FortiGate ML2 plugin. With this plugin, the FortiGate acts as the network node in the OpenStack environment.

In this example, we use a FortiGate VM. In a production network, the MSSP would use a FortiGate device.

Configuration

Each of the VM's is attached to the control network and the tenant network. In addition, the FortiGate attaches to the external network. In this demo, the external network is the same as the control network. In a production configuration, the external network would be separate.



What's Next

After the installation, you can run the following examples on your OpenStack:

"Tenant Networks" on page 40 - create a tenant network

"FortiGate as Guest VM in OpenStack" on page 27 - create a FortiGate VM to control traffic between VMs

Preparation

This example requires two VMs running Ubuntu Linux and a FortiGate VM.

The following preparation steps are required:

1. Create a vSwitch for the Tenant Network

From vSphere, run the following commands:

1. Select the host server.
2. Create a standard vSwitch.
3. Do not select any physical adapters.
4. Set the network label to Tenant Network.
5. Set the VLAN id to All.
6. Edit the vSwitch. In the security tab, set promiscuous mode.

2. Create Two VMs (Controller Node, Compute Node)

Use the following minimum settings:

- 2 Cores
- 4G RAM
- Two network adapters

3. Install Ubuntu 14.04 on the Controller and Compute VMs

4. Install Git and OpenSSH. Create a new user named stack.

Run the following commands on the Controller and Compute VMs:

```
apt-get update
apt-get install git openssh-server
sudo adduser stack
sudo gpasswd -a stack sudo
```

Edit the file /etc/network/interfaces to configure eth0: Control/Management network and eth1: Tenant Network:

```
auto eth0
iface eth0 inet static
```

```
    address 172.30.71.224
    netmask 255.255.255.0
    gateway 172.30.71.1
    dns-nameservers 172.30.68.8  172.30.68.9
auto eth1
iface eth1 inet manual
    up ifconfig $IFACE 0.0.0.0 up
    up ip link set $IFACE promisc on
    down ip link set $IFACE promisc off
    down ifconfig $IFACE 0.0.0.0 down
```

5. Create a FortiGate VM

From the Fortinet support site, download the OVA for FortiGate VM 5.2.3 or higher version

We use three interfaces on the FGT-VM:

- port1: Control/Management network
- port2: Tenant network
- port3: External network (this can be the same network as port1)

Refer to the following document for instructions on how to download and deploy the FGT OVA file:

http://docs.fortinet.com/d/fortigate-vm-install-guide

6. FortiGate VM basic configuration

Do not configure port2 or port3. The ML2 plugin will automatically set up the initial configuration.

From the VMware console, configure port1:

```
config system interface
    edit port1
        set ip 172.30.71.222  255.255.255.0
        set allowaccess ping https http ssh snmp telnet
    end
```

7. Install the FortiGate License

Now that you have configured port1, you should be able to HTTP to the FortiGate VM and use the web-based Admin interface to install the FGT-VM license.

To enable VDOMs (next step), you must install a VM04 or VM08 license.

8. Enable VDOMs

After you install the license, you can enable VDOM using the following commands:

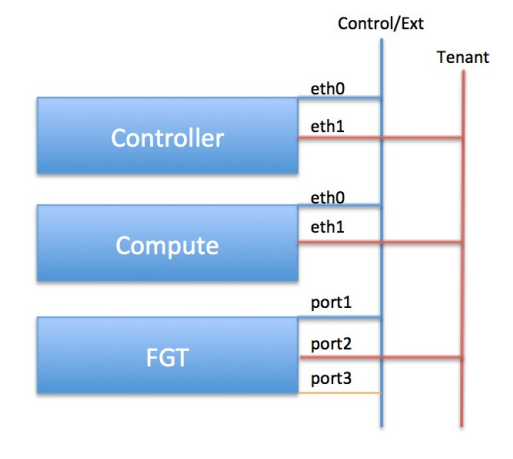
```
config system global
   set vdom-admin enable (note: this is a hidden command)
```

9. Test the Network Connectivity

Ensure that you have connectivity (on the control/management network) between the three VMs

Test that you can access the internet from the Controller and Compute VMs

The following diagram shows the network connections. On the FortiGate, the control and external interfaces are attached to the same network:



Install DevStack and ML2 Plugin

The examples in this section assume the following VM port1 IP address values:

Controller VM: 10.98.1.200

Compute VM: 10.98.1.201

FortiGate VM: 10.98.1.202

To execute this set of instructions, log in as user "stack" . Unless otherwise specified, execute the commands on both nodes (controller and compute).

1. Download the ML2 Plugin

a. Navigate to the Fortinet Support site.
b. Select **Download -> Firmware image**, select product **FortiGateConnector** and click the **Download** tab.
c. Click **Openstack- -ML2** and download "FortiGate_Connector_OpenStackML2- -1.0.0.tar.gz"

2. Download the DevStack Software (stable Liberty version)

Run "git clone https://github.com/openstack-dev/devstack -b stable/liberty" and save it to /home/stack directory.

3. Copy local.conf file to the Devstack folder

For the controller node:

Copy ~stack/networking-fortinet/devstack/local.conf.example.controller to ~stack/devstack/local.conf

For the compute node:

Copy ~stack/networking-fortinet/devstack/local.conf.example.compute to ~stack/devstack/local.conf

4. Modify the local.conf file

Edit the /devstack/local.conf file. Search for the #CHANGEME comments.

Set the following fields for the controller node:

a. FortiGate IP address
b. FGT ports for tenant traffic
c. FGT port for external traffic
d. Set control plane interface.

Example:

```
# fortigate ml2 plugin parameters
     # CHANGEME: ip address of the fortigate rest API
     Q_FORTINET_PLUGIN_FG_IP=10.98.1.202
     # CHANGEME: interface for tenant traffic
     Q_FORTINET_PLUGIN_FG_INT_INF=port2
     # CHANGEME: interface for external traffic
     Q_FORTINET_PLUGIN_FG_EXT_INF=port3
     # CHANGEME: if use fortivm set to False, True if hardware npu available
     #Q_FORTINET_PLUGIN_NPU_AVAILABLE=False


  # networking configuration parameters
     # CHANGEME: control plane nic
     HOST_IP_IFACE=eth0
```

Set the following fields for the compute node:

a. Interface for tenant traffic
b. The control plane interface
c. IP address of the Nova compute node (this node)
d. IP address of the controller node

Example:

```
  # fortigate ml2 plugin parameters
     # CHANGEME: The interface for tenant traffic
     Q_FORTINET_TENANT_INTERFACE=eth1

  # networking configuration parameters
     # CHANGEME: control plane nic
     HOST_IP_IFACE=eth0

  # CHANGEME: management ip of the nova compute node
     NOVA_SERVICE_LOCAL_HOST=10.98.1.201

  # CHANGEME: hostname or ip of controller
     SERVICE_HOST=10.98.1.200
```

5. Take a Snapshot

We recommend that you take a snapshot of both VMs at this point. The snapshot provides a good recovery point in the event that the **stack.sh** script runs into problems.

6. Run stack.sh on the Controller Node

Run “stack.sh” on Controller node first. under ~stack/devstack.

You will see following message when the stack script completes successfully:

```
 This is your host IP address: 10.98.1.200
This is your host IPv6 address: fe80::20c:29ff:fe8e:a13a
Horizon is now available at http://10.98.1.200/dashboard
Keystone is serving at http://10.98.1.200:5000/
The default users are: admin and demo
The password: fortinet done
./stack.sh: line 1384: 8762 Terminated spinner
...[/]./stack.sh: line 344: 3: Bad file descriptor
stack@UbuntuCtrl:~/devstack$ 2016-03-29 23:06:25.068 | stack.sh log
/opt/stack/logs/stack.sh.log.2016-03-29-152417Installing package prerequisites
Installing OpenStack project source
Starting RabbitMQConfiguring and starting MySQLStarting Keystone
Configuring and starting HorizonConfiguring Glance
...
```

7. Run stack.sh on Compute Node

Run “stack.sh” on the Compute node, under ~stack/devstack.

You will see following message when the stack script completes successfully:

```
This is your host IP address: 10.98.1.201
This is your host IPv6 address: fe80::20c:29ff:fe0e:c12
done
./stack.sh: line 1384: 8762 Terminated spinner
...[/]./stack.sh: line 344: 3: Bad file descriptor
stack@UbuntuCtrl:~/devstack$ 2016-03-29 23:06:25.068 | stack.sh log
/opt/stack/logs/stack.sh.log.2016-03-29-152417Installing package prerequisites
Installing OpenStack project source
...
```

8. Open the OpenStack Dashboard

The stack.sh script creates a demo project and one private network.

You will be able to login OpenStack with https://<IP address of Controller node>

use ID: **admin** and password: **secretsecret** (the admin password that you set in local.conf)

9. Verify the Installation

Navigate the the FortiGate Admin,

Verify that the FortiGate is configured with two VDOMs:

- “osvdmext”: to control connectivity with external network
- “osvdm1”: to inspect traffic for the “demo” tenant

.

Use Demo Scripts to Create Tenant Networks

The FortiGate ML2 plugin includes the following demo scripts:

demo.sh:

```
demo.sh <action> <tenant name>
```

Enter a new tenant name, and specify one of the following actions:

- add-tenant
- create-public-net
- create-tenant-net
- boot-vm

demo_wrapper.sh:

```
demo_wrapper.sh <tenant name>
```

Enter a new tenant name. This command performs all four of the above actions.

1. Copy the scripts to stack/devstack

From the stack home directory, navigate to networking-fortinet/devstack, and copy demo.sh and demo_wrapper.sh to stack/devstack

2. Set the Environment Variables

Run the following command to set the OpenStack environment variables:

```
source openrc admin admin
```

3. Run the demo_wrapper command

```
./demo_wrapper.sh <tenant name>
```

The command requires one parameter, which is the name of the tenant. This command performs the following:

- adds a tenant
- creates the public network (if it does not already exist)
- creates the tenant's private network
- launches a VM

4. Run the demo command

You can run the demo command to execute individual sub-commands.

```
./demo.sh <action> <tenant name>
```

Enter a new tenant name, and specify one of the following actions:

- add-tenant
- create-public-net
- create-tenant-net
- boot-vm

5. View Results

Log in to the Horizon Dashboard using the admin user to view all of the tenant networks.

Note: After you add a new tenant, you need to log out and log in again for the tenant to become visible.

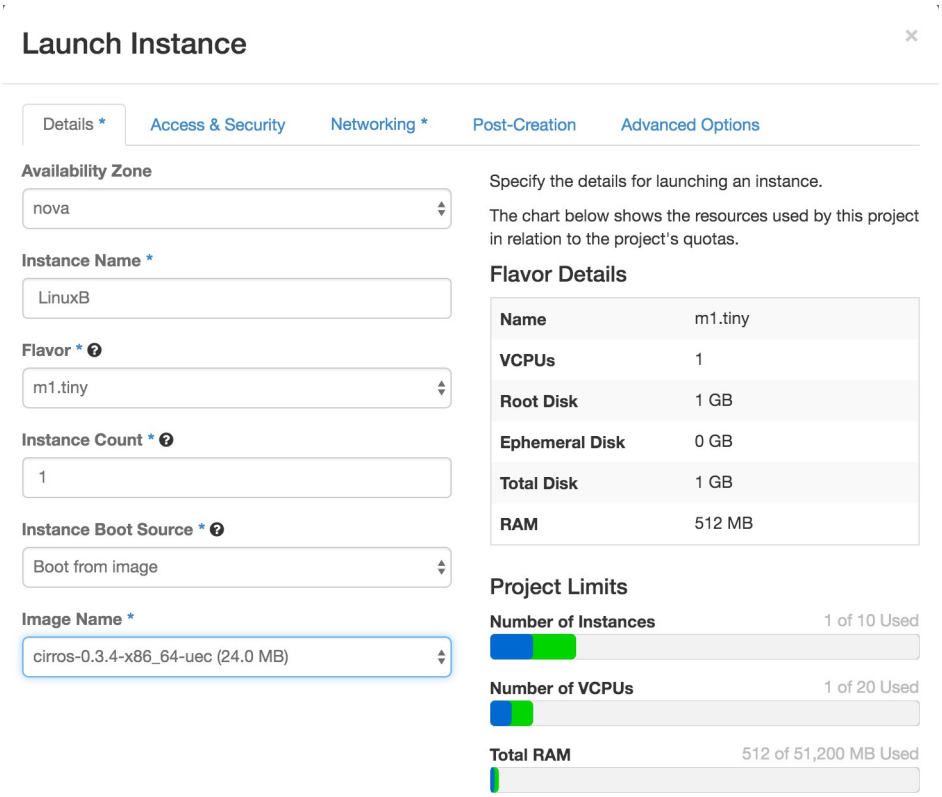
Log in to the FortiGate Admin UI to see the VDOM configurations for each tenant.

Launch a Cirros Instance

1. Launch Instance Details tab

Go to the “demo” project,
Project -> Compute -> Instances and click **Launch Instance.**

In the Details tab, enter a name, select flavor, select boot from image and select the cirros image

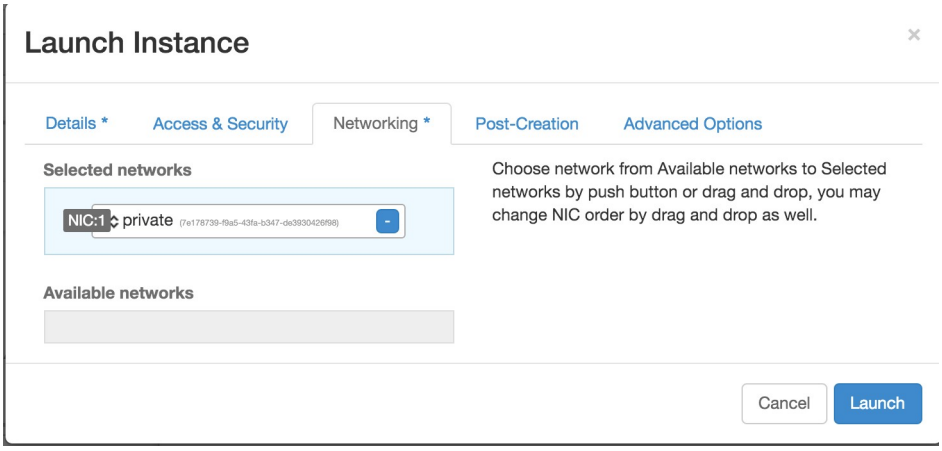


2. Networking tab

Click the **Networking** tab.

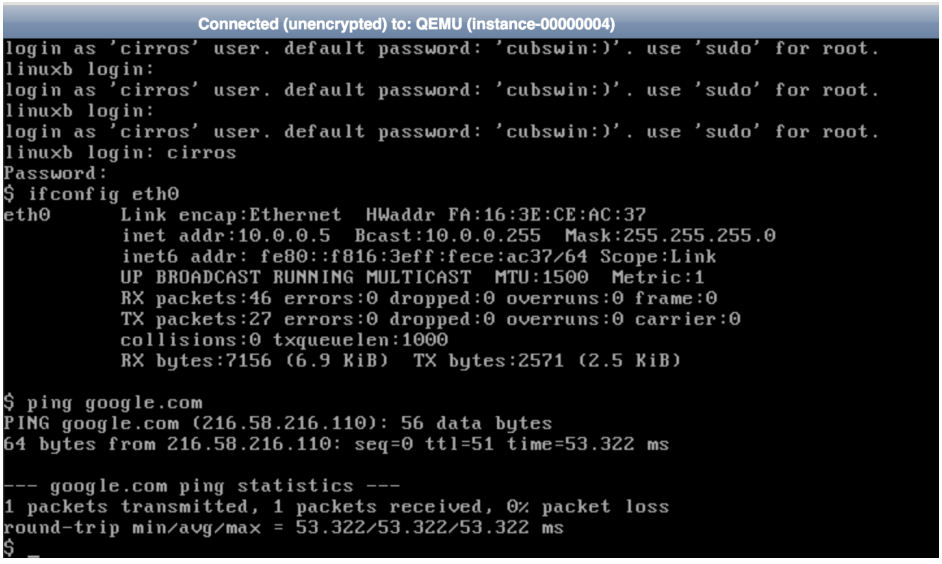
Ensure that the private network is selected.

Click **Launch**.



3. Ping the public network

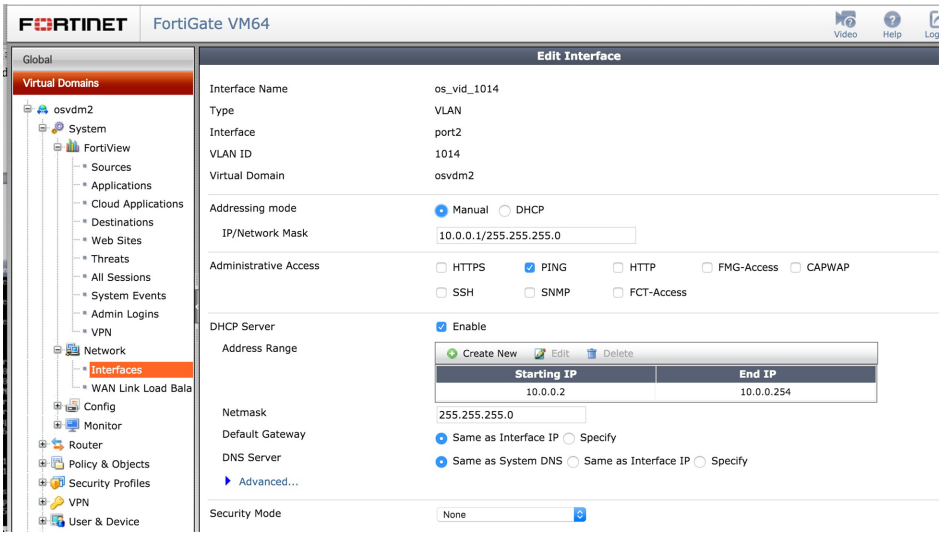
If ping to 8.8.8.8 (google DNS) works but google.com does not work, your DHCP DNS setting on FortiGate is not correct.



4. Update FortiGate DNS setting

Go to
Virtual Domains -> Network -> Interfaces

Change the DNS server to “Same as System DNS”.

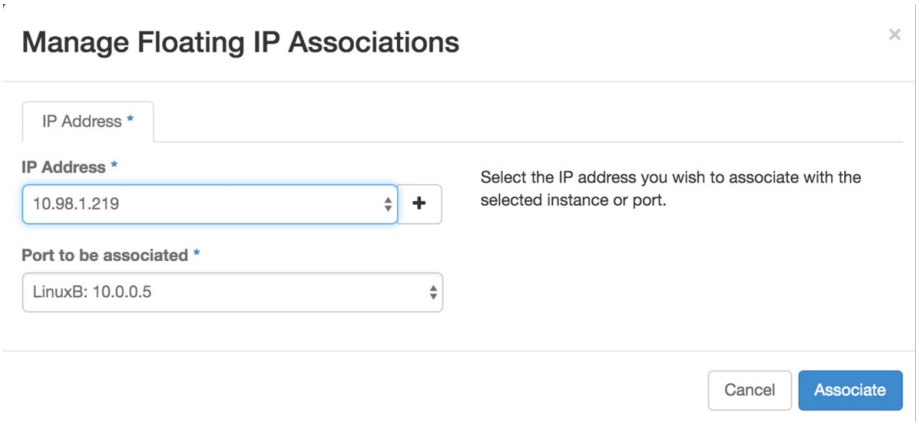


5. Manage Floating IP setting

Go to
Compute -> Instances

Click pull down Actions menu and select **Associate Floating IP**

Pick one floating IP and click **Associate**



FortiGate as Guest VM in OpenStack

You can run FortiGate VM in your OpenStack environment, to provide Firewall services for traffic between the tenant VMs.

This section contains the following examples:

"Run FortiGate as Guest VM in OpenStack " on page 28

This example uses the Horizon dashboard and some OpenStack CLI commands to perform the following steps:

1. Download FGT and FMG VM images
2. Prepare the DevStack Environment
3. Create two private networks
4. Create Fortinet Access & Security Profile
5. Deploy a FGT VM
6. Deploy a FMGR VM
7. Connect to FortiGate-VM

"Using Cloud-init to Launch FortiGate as Guest VM" on page 38

1. Create a text file to contain the parameters that you want to configure on the FortiGate.
2. Use the nova command to launch the FortiGate VM and run the configuration file automatically.

Run FortiGate as Guest VM in OpenStack

This section describes how to install and run FortiGate as a Guest VM in the OpenStack environment.

The objective is to demonstrate how a FortiGate-VM can monitor network traffic between VMs created in an OpenCloud environment.

From a browser, connect to the Horizon dashboard and log in with the demo user name and password.

1. Download FortiGate and FortiManager VM Image Files

Download the FortiManager and FortiGate KVM images from support.fortinet.com. The image names will have the following format:

- FortiGate: FGT_VM64_KVM-v5-build1011-FORTINET.out.kvm.zip
- FortiManager: FMG_VM64_KVM-v5-build1019-FORTINET.out.kvm.zip

Unzip the .qcow files, and upload them to your Ubuntu server. The commands below assume that the image files are stored in a directory named **images**, which is a peer directory to **devstack**.

2. Prepare the DevStack Environment

Run the openrc file. This sets environment variables for you to run OpenStack commands:

```
# source openrc admin admin
```

Create a flavor for FortiGate-VM (1 G of RAM, 20 G disk, 1 vCPU):

```
# nova flavor-create m1.fgt-vm 6 1024 20 1
```

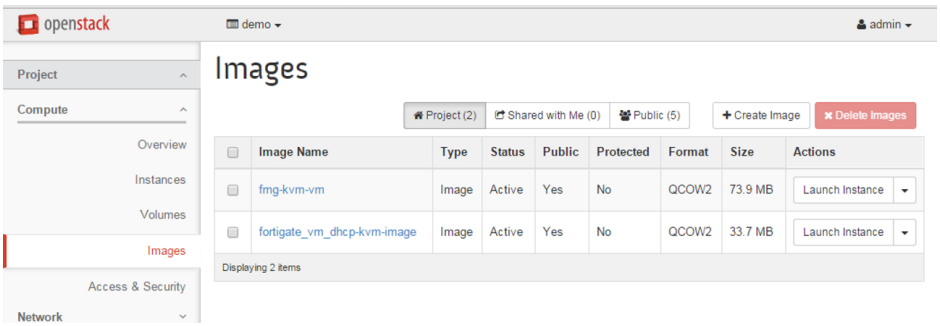
Create a KVM image for FortiGate-VM:

```
glance image-create --name fortigate_vm_dhcp-kvm-image --disk-format qcow2 --is-
public True --container-format bare --file ../images/fortios.qcow2
```

Create a FortiManager-VM KVM image for license validation

```
glance image-create --name fmg-kvm-vm --disk-format qcow2 --is-public True --con-
tainer-format bare --file ../images/fmg.qcow2
```

You should now see your images from the dashboard:

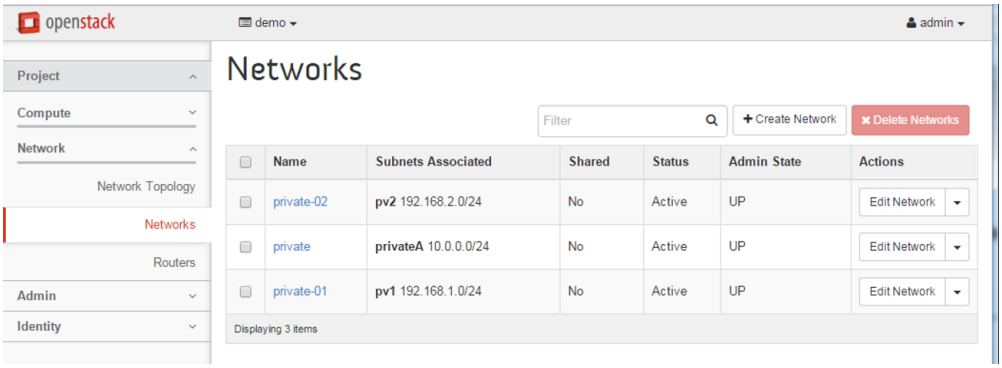


You can also check the images from the CLI:

```
$  nova image-list
```

3. Create Private Networks

From the Horizon demo account, create two private networks: private-01 and private-02. For each of them, disable the default gateway and leave DHCP enabled:



4. Create Fortinet Access & Security Profile

Enter the following commands to allow all ICMP, UDP, TCP and HTTP(s) traffic:

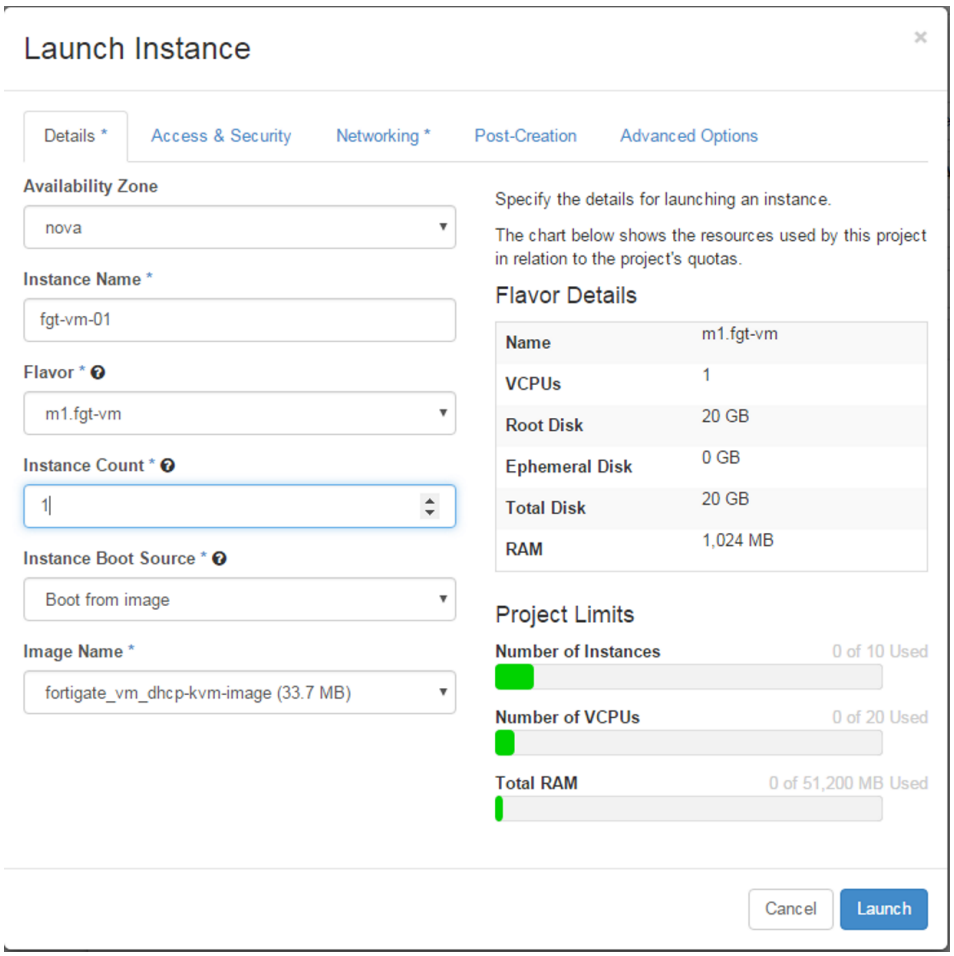
```
neutron security-group-create fortinet
neutron security-group-rule-create --protocol icmp --direction ingress --remote-
ip-prefix 0.0.0.0/0 fortinet
neutron security-group-rule-create --protocol icmp --direction egress --remote-ip-
prefix 0.0.0.0/0 fortinet
neutron security-group-rule-create --protocol tcp  --port-range-min 80 --port-
range-max 80 --remote-ip-prefix 0.0.0.0/0 fortinet
neutron security-group-rule-create --protocol tcp  --port-range-min 443 --port-
range-max 443 --remote-ip-prefix 0.0.0.0/0 fortinet
neutron security-group-rule-create --protocol tcp  --remote-ip-prefix 0.0.0.0/0 --
direction ingress fortinet
neutron security-group-rule-create --protocol tcp  --remote-ip-prefix 0.0.0.0/0 --
direction egress fortinet
```

```
neutron security-group-rule-create --protocol udp  --remote-ip-prefix 0.0.0.0/0 --
direction ingress fortinet
neutron security-group-rule-create --protocol udp  --remote-ip-prefix 0.0.0.0/0 --
direction egress fortinet
```

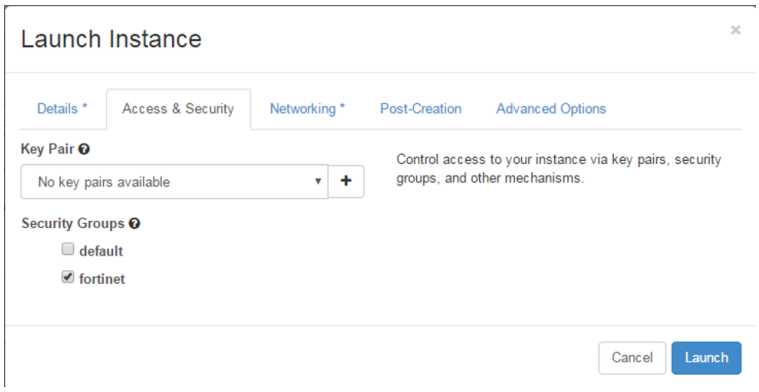
5. Deploy a FortiGate-VM

From the Horizon, navigate to **Compute>Images** and launch a FortiGate-VM instance. Set the following:

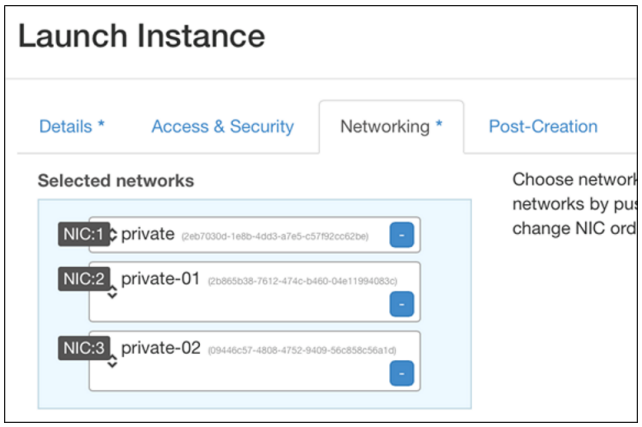
- **Instance Name**: enter **fgt-vm-01**
- **Flavor**: select **m1.fgt-vm**
- **Image Name**: select the FortiGate KVM image



From the **Access & Security** tab, select **fortinet** as the Access & Security Profile.



From the **Network** tab, select all three networks:



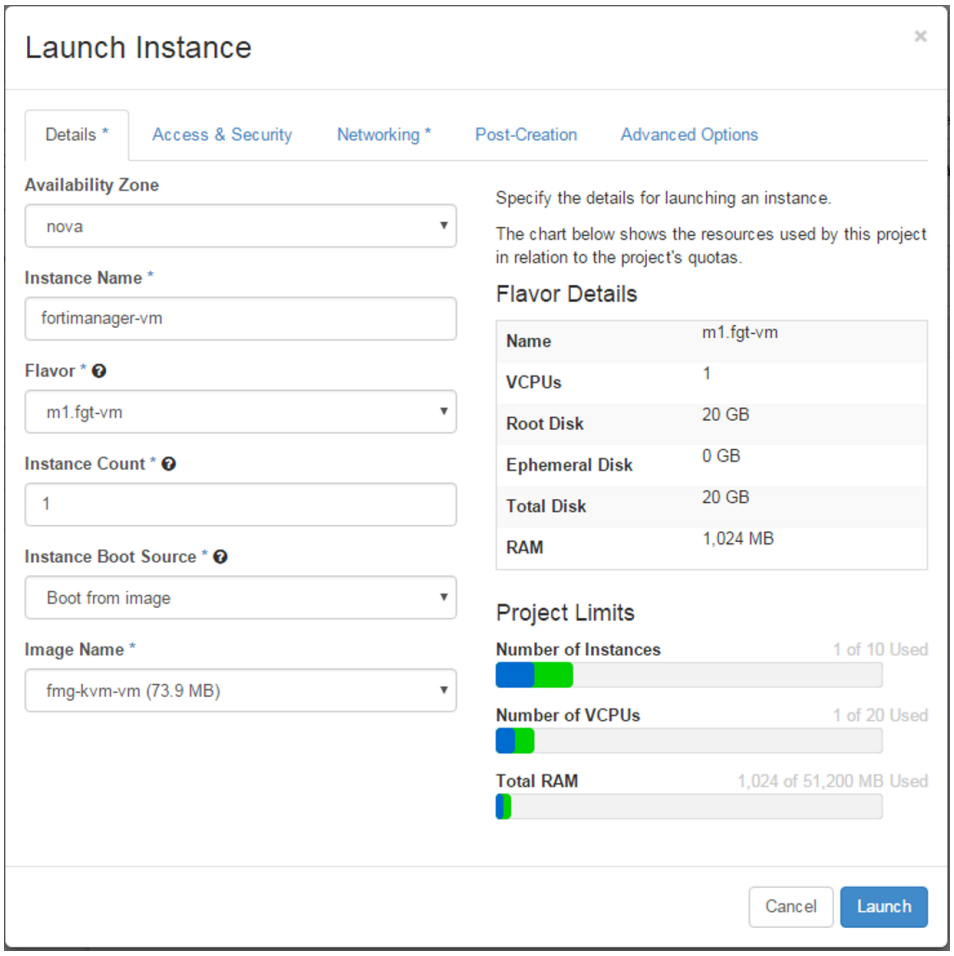
If the VM launch is successful, **Compute>Instances** will show the FGT instance.

6. Deploy a FortiManager VM

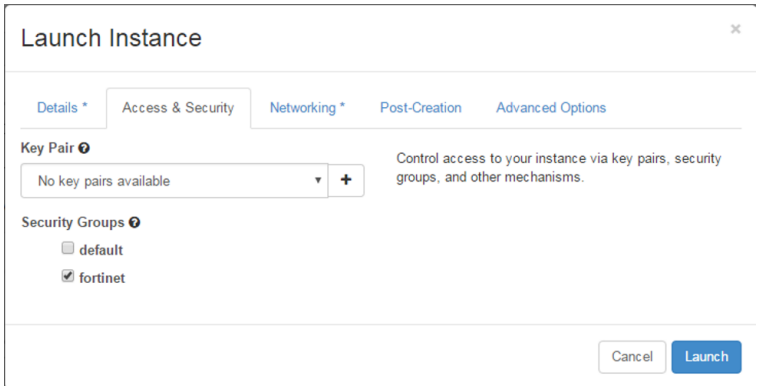
FortiManager-VM is required for validation of the FortiGate license .

Launch a FortiManager-VM instance. Set the following:

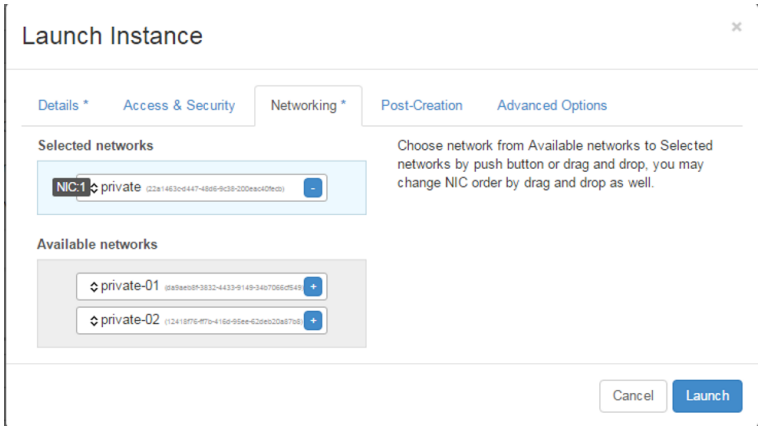
- **Instance Name**: enter **fortimanager-vm**
- **Flavor**: select **m1.fgt-vm**
- **Image Name**: select the FortiManager KVM image



From the **Access & Security** tab, select **fortinet** as the Access & Security Profile.



Connect the FortiManager-VM to the private network:



If the VM launch is successful, **Compute>Instances** will show the FortiManager instance.Note the IP address assigned to this instance.

FortiManager ports don't support DHCP, so you need to configure the IP address manually.

Click on the FortiManager instance to open the instance details. Click on the console tab to open a console session and configure the IP address.

FortiGate-VM Registration

Connect to the FortiGate VM IP address and upload the license.

After the reboot, configure FortiManager as a FortiGuard DB (the server IP address is the FortiManager address):

```
FGVM080000030547 (0) # show
   config server-list
      edit 1
         set server-type update rating
         set server-address 10.0.0.5
      next
   end
```

Trigger license update

```
FGVM080000030547 # execute send-fds-statistics
FGVM080000030547 # execute update-now
```

7. Connect to FortiGate-VM

From your Ubuntu VM, you should now be able to HTTP to your FortiGate VM.

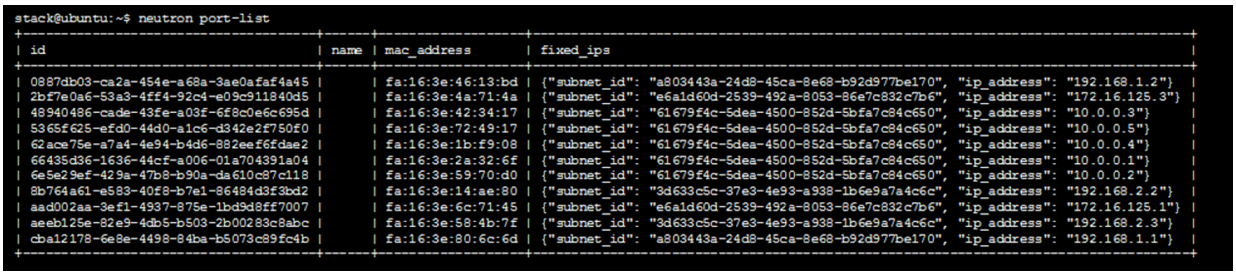
From the CLI console, change port2 and port3 mode from static to dhcp and disable the default gateway

```
FGVM080000030547 (port2) # show
config system interface
   edit "port2"
      set vdom "root"
      set mode dhcp
      set allowaccess ping
      set type physical
      set snmp-index 2
      set defaultgw disable
   next
end
FGVM080000030547 (port3) # show
config system interface
   edit "port3"
      set vdom "root"
      set mode dhcp
      set allowaccess ping
      set type physical
      set snmp-index 3
      set defaultgw disable
   next
end
```

A. Enable forwarding on the FortiGate-VM

From **Compute>Instances**, find the IP addresses of the FGT-VM ports connected to the networks private-01 and private-02:

Run the `neutron port-list` command to list the neutron port ids:



From the IP address field, identify the neutron port IDs of the two ports (the following is a truncated output of the above screen-shot):

```
+--------------------------------------+----+-------------------+-------------
| id                                   |name| mac_address       | fixed_ips
+--------------------------------------+----+-------------------+-------------
| 0887db03-ca2a-454e-a68a-3ae0afaf4a45|    |fa:16:3e:46:13:bd| "192.168.1.2"

...

| aeeb125e-82e9-4db5-b503-2b00283c8abc|    |fa:16:3e:58:4b:7f| "192.168.2.3"
+--------------------------------------+----+-------------------+-------------
```

Disable the security group and the port security on the 2 ports:

```
neutron port-update 0887db03-ca2a-454e-a68a-3ae0afaf4a45 --no-security-groups --
port_security_enabled=False

#neutron port-update aeeb125e-82e9-4db5-b503-2b00283c8abc --no-security-groups --
port_security_enabled=False
```

Verify the port security status, by running the port-show command:

```
#stack@ubuntu:~$ neutron port-show aeeb125e-82e9-4db5-b503-2b00283c8abc
+-----------------------+-------------------------------------------------+
| Field                 | Value                                           |
+-----------------------+-------------------------------------------------+
| admin_state_up        | True                                            |
| allowed_address_pairs |                                                 |
| binding:host_id       | ubuntu                                          |
| <truncated>
| device_owner          | compute:nova                                    |
| extra_dhcp_opts       |                                                 |
| fixed_ips             | "ip_address": "192.168.2.3"                     |
| id                    | aeeb125e-82e9-4db5-b503-2b00283c8abc            |
| mac_address           | fa:16:3e:58:4b:7f                               |
| name                  |                                                 |
| network_id            | fc015239-4e77-4cfb-ae40-65d5c1d4a717            |
| port_security_enabled | False                                           |
| security_groups       |                                                 |
| status                | ACTIVE                                          |
| tenant_id             | 84cbb0f0fcd54b319c12dd0307e94894                |
+-----------------------+-------------------------------------------------+
```

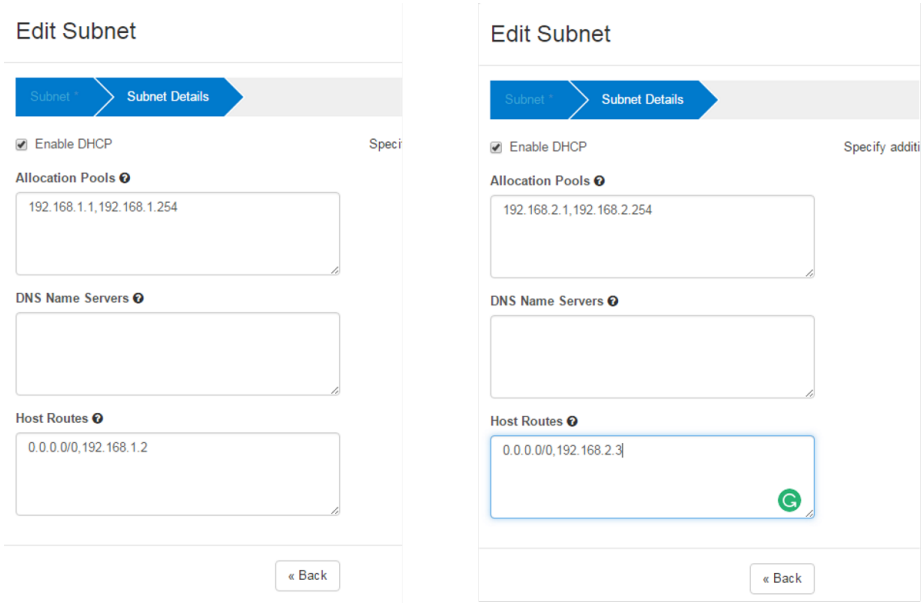
B. Network Configuration Update

Navigate to Network>Networks.Click the network **private-01**, then click **Edit Subnet** for subnet **pv1**, then click **Subnet Details**.

Modify the **Host Routes** to add a default route pointing to the FGT IP address.

Repeat this configuration for the private-02 network.

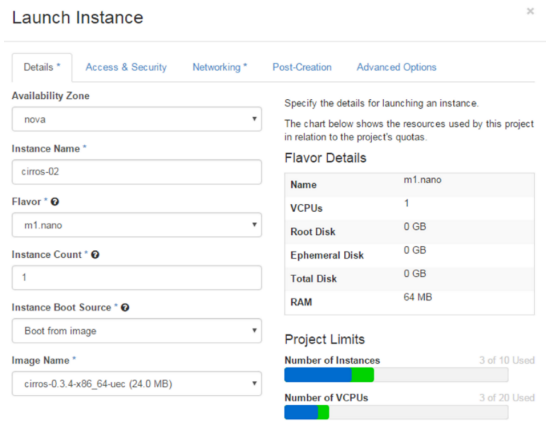
The image below shows the values for **private-01** and **private-02**.



C. Deploy Cirros VMs

Deploy two cirros VMs, one on **private-01** and one on **private-02** with the following values:

- Instance Name: **cirros-01** and **cirros-02**
- Flavor: **m1.nano**



Click on the cirros-01 instance to open the instance details. Click on the console tab to open a console session.

Verify the routing table in each instance – ensure that the default route points to the FGT-VM

cirros-01:

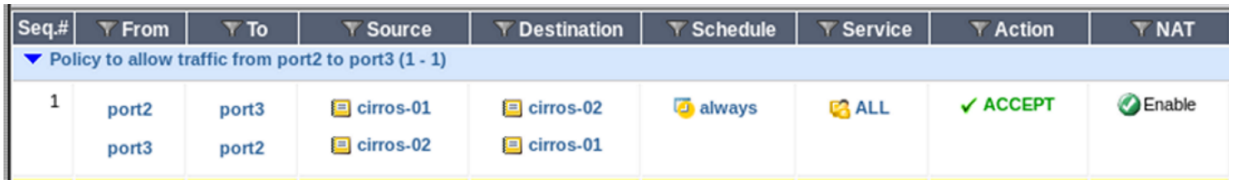
```
$ ip route
default via 192.168.1.2 dev eth0
192.168.1.0/24 dev eth0 src 192.168.1.3
```

cirros-02:

```
$ ip route
default via 192.168.2.3 dev eth0
192.168.2.0/24 dev eth0 src 192.168.2.4
```

E. Create Firewall policies on FGT-VM

From the FGT-VM web-based admin, create a firewall policy to allow communication between cirros-01 and cirros-02



Seq.#	From	To	Source	Destination	Schedule	Service	Action	NAT
Policy to allow traffic from port2 to port3 (1 - 1)								
1	port2 port3	port3 port2	cirros-01 cirros-02	cirros-02 cirros-01	always	ALL	✓ ACCEPT	Enable

The two cirros VMs should be able to ping each other.

Using Cloud-init to Launch FortiGate as Guest VM

Instead of launching the FortiGate VM from the Horizon GUI, you can use CLI commands and use Cloud-init to initialize the FortiGate VM.

The following prerequisites are covered in Run FortiGate as Guest VM in OpenStack.

Prerequisites

1. Cloud-init requires FortiOS 5.4.1 or higher release for the FortiGate VM.
2. Run the source command
3. Download FGT-VM image file.
4. Create an image flavor for FGT-VM
5. Create the image using Glance
6. Download the License file to the same directory as the images.

The commands below assume that the image files and license file are stored in a directory named **images**, which is a peer directory to **devstack**.

Steps:

1. Create FortiGate initial configuration file

Create the FortiGate initial configuration file (fgtinit.txt) in the **images** directory.

2. Edit the FGT initial configuration file.

The command syntax is the same as CLI commands:

```
config system global
   set hostname OpenStackTest
end
config system interface
   edit "port1"
      set mode dhcp
      set allowaccess ping https ssh fgfm
   next
end
config system central-management
   set type fortimanager
   set fmg "10.100.14.222"
      config server-list
         edit 1
            set server-type update rating
            set server-address 10.100.14.222
         next
```

```
    end
end
```

3. Get the Image id and Network id

Run the following commands to get the image id and the network id of the private network

```
$  nova image-list
$  nova network-list
```

4. Run Nova Boot Command

The following example launches a FGT-VM instance (FGT-VM-CSE-Demo) in the demo project and connect to the private network. The user-data parameter names the post-creation user file, and the file command makes the license file available to the newly-created instance.

```
nova boot
   -os-tenant-name demo
   -config-drive true
   -flavor m1.fgt-vm
   -image  f1a6dfde-fbb3-4861-85ef-b88bd28f1b8e
   -user-data=fgtinit.txt
   -nic net-id=5fb6e777-8f38-44e3-a0e5-71b747c61c11
   -file  license=FGVM080000059099.lic
   FGT-VM-CSE-Demo
```

5. Verify

Check the console to see the FortiGate VM load the initial configuration and the license file.

Tenant Networks

This section contains examples related to tenant network.

Examples include:

"Configure External Network" on page 41

Without the external network, tenants can only access other tenants on this host.

"Create the Tenant Network" on page 44

This example uses the Horizon Dashboard to create the infrastructure required for a tenant network.

Configure External Network

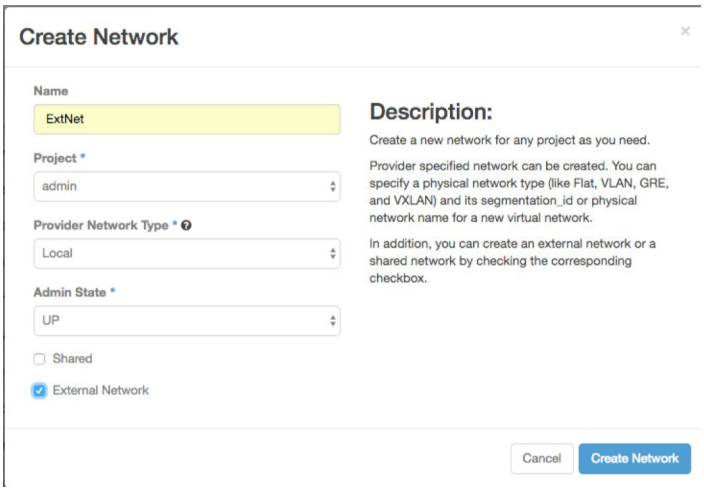
Using the admin project, create an external network. All of the tenant VM's communicate externally through this network.

1. Create the network

From the “admin” project:

Go to **System -> Networks** and click “**Create Network**

Enter the network name as **ExtNet**,
select Project **admin**,
and check **External Network**

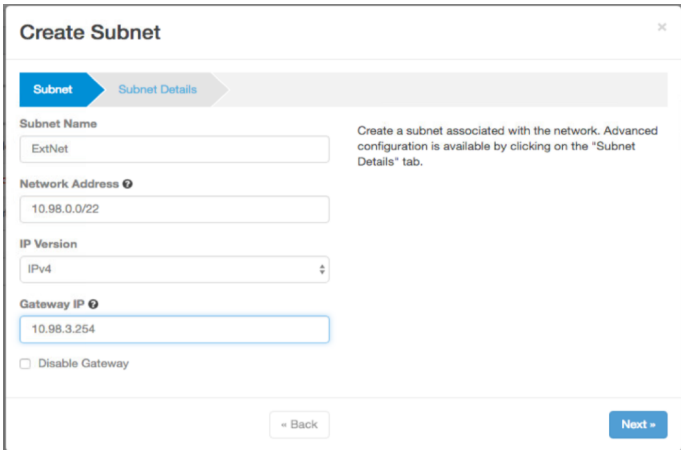


2. Create a subnetwork

Go to **Project -> Network -> Networks**

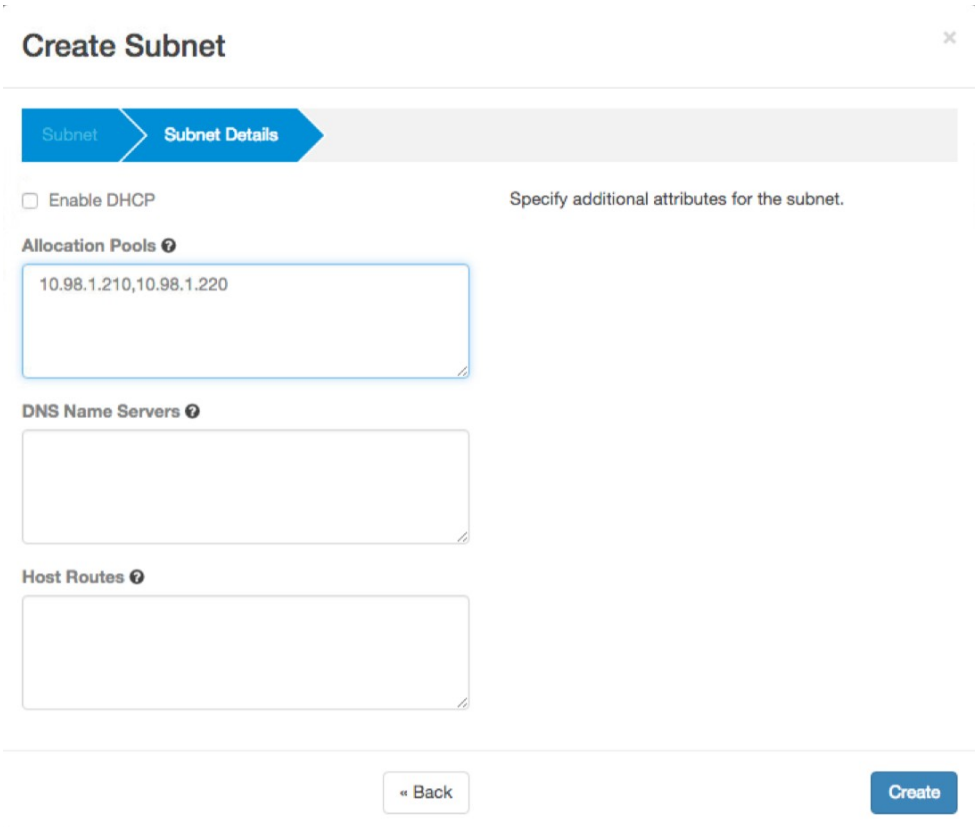
For the ExtNet network, click the **Actions** pull down and select **Add Subnet**.
Assign a subnet address and a gateway IP address.

Click Next to go to the **Subnet Details** tab



Uncheck DHCP and add an Allocation Pool (this is the Floating IP range).

Click **Create** to create the subnet.



Create the Tenant Network

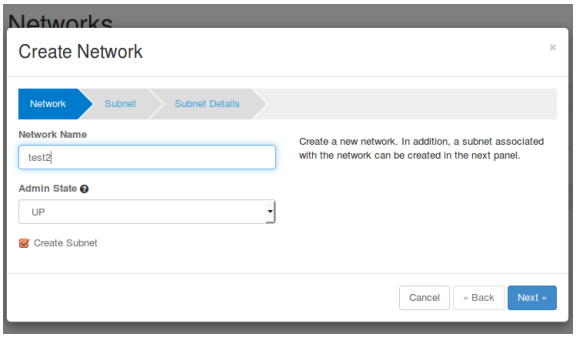
Tenants can log in and create their tenant network. Tenant creates a router attached to the external network.

All of the tenant VM's communicate externally through this network.

1. Create the network

Go to **System -> Networks** and click "**Create Network**

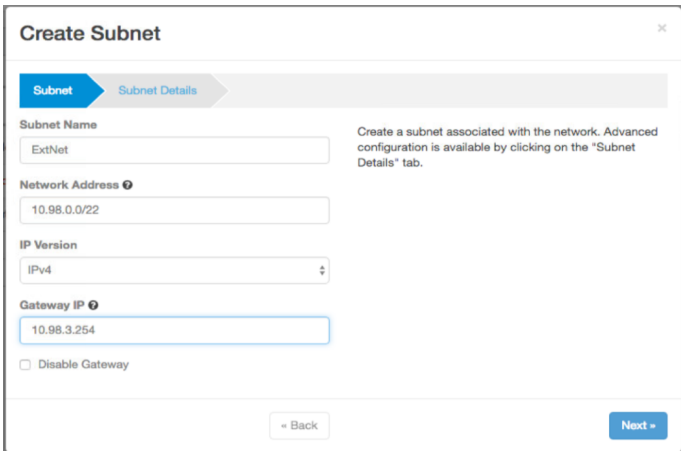
Enter the network name.



2. Create a subnetwork

Go to **Project -> Network -> Networks**

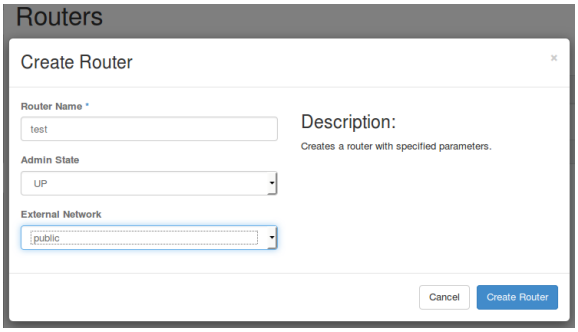
For the Tenant network, click the **Actions** pull down and select **Add Subnet**.
Assign a subnet address and a gateway IP address.



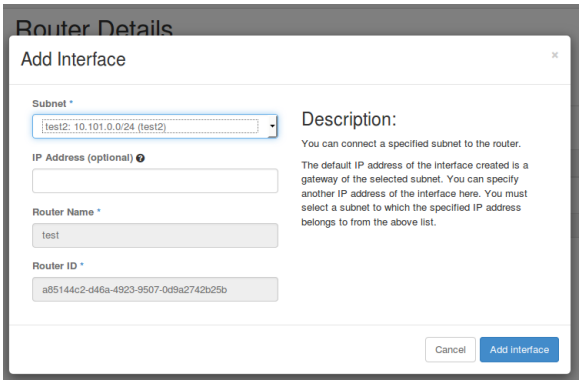
3. Configure the Router

Go to **Network -> Routers**

Click **Create Router**, enter a name for the router and select the External Network.



After the router is created, click the router in the list and select the **Interface** tab. Click **Add Interfaces** and select the tenant network.

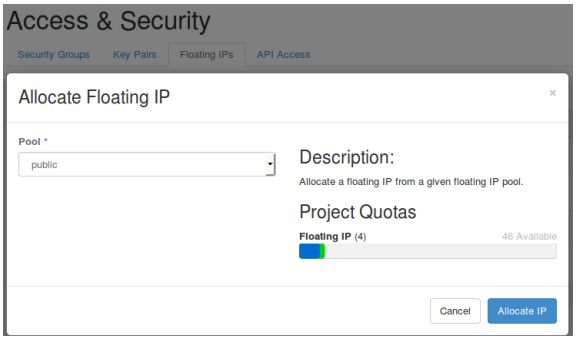


4. Allocate Floating IP

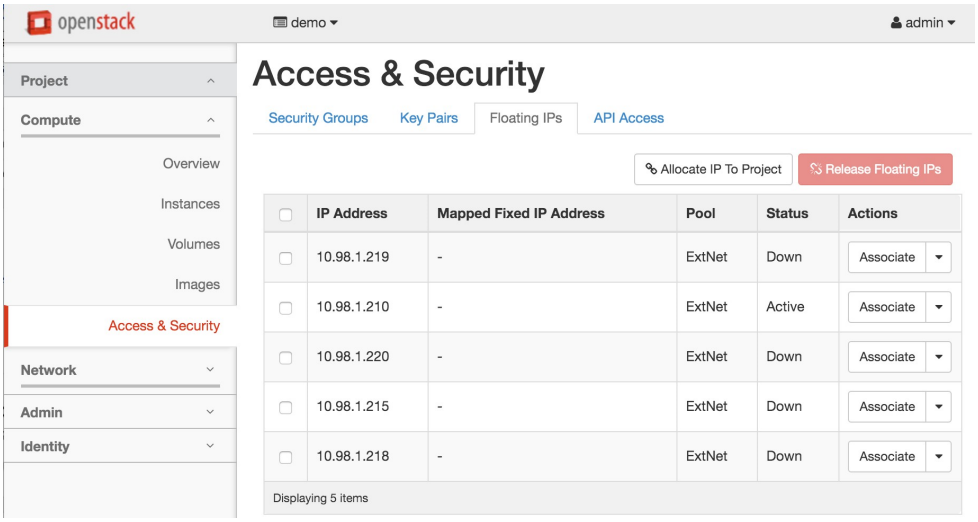
From the “demo” project:

Go to **Project -> Compute -> Access & Security** and click **Floating IPs** tab.

Click **Allocate IP to Project**, select **public** as Pool.



You will see allocated floating IP address.



Heat Orchestration Templates (HOT)

HOT is a new template format meant to replace the Heat Cloud Formation-compatible format (CFN) as the native format supported by Heat.

This guide is targeted towards template authors and explains how to write HOT templates, based on examples.

A detailed specification of HOT can be found here: Heat Orchestration Template (HOT) specification.

Basic Template

The most basic template may contain only a single resource definition using only predefined properties (along with the mandatory Heat template version tag).

Each HOT template has to include the heat_template_version key with a valid version of HOT, e.g. 2015-10-15 (see Heat template version for a list of all versions).

While the description is optional, it is good practice to include some useful text that describes what users can do with the template. To provide a longer description that does not fit on a single line, you can provide multi-line text in YAML, as shown in the following example.

The resources section is required and must contain at least one resource definition. In the following example, a single compute instance is defined with fixed values for the 'key_name', 'image' and 'flavor' parameters:

```
heat_template_version: 2015-04-30


description: > Simple template to deploy
                a single compute instance

resources:
   my_instance:
       type: OS::Nova::Server
       properties:
         key_name: my_key
         image: F18-x86_64-cfntools
         flavor: m1.small
```

Template Input Parameters

Input parameters defined in the parameters section of a HOT template allow users to customize a template during deployment. For example, the user can provide custom key-pair names or image IDs to be used for a deployment. A template becomes more easily reusable by avoiding hard-coded assumptions.

In the following example, three input parameters have been defined that have to be provided by the user upon deployment. The fixed values for the respective resource properties have been replaced by references to the corresponding input parameters by means of the get_param function:

```
heat_template_version: 2015-04-30


description: > Simple template to deploy
                a single compute instance
parameters:
  key_name:
    type: string
    label: Key Name
    description: Name of key-pair to be used for compute instance
  image_id:
    type: string
    label: Image ID
    description: Image to be used for compute instance
  instance_type:
    type: string
    label: Instance Type
    description: Type of instance (flavor) to be used
    default: m1.small

resources:
   my_instance:
       type: OS::Nova::Server
       properties:
         key_name: { get_param: key_name }
         image:  { get_param: image_id }
         flavor: { get_param: instance_type }
```

Note that you can specify a default value, which will be used if the user does not specify a value.

Template Outputs

You will typically provide outputs to users using the outputs section of a template. For example, the IP address for the instance (defined in the example above) should be provided to users. Otherwise, users would have to look it up themselves. The definition for providing the IP address of the compute instance as an output is shown in the following snippet:

```
outputs:
  instance_ip:
    description: The IP address of the deployed instance
    value: { get_attr: [my_instance, first_address] }
```

Examples

This section includes the following examples:

- "Using Heat to instantiate a FOS-VM" on page 55
- "Using Heat to configure FortiGate" on page 51

Using Heat to configure FortiGate

This example describes a HEAT template for configuring FortiGate.

This template shows how to configure FortiGate via config-drive and to install a license and also to demonstrate passing parameters via heat command line to be interpolated into the config-drive configuration template.

This heat template uses a config-drive file to configure the hostname and admintimeout of a FortiGate instance. The config-drive file (fgt.txt) contains:

```
config system global
   set hostname $HOSTNAME
   set admintimeout $TIMEOUT
end
```

They heat template uses the “str_replace” function and “template” parameter. To replace specific text in the config-drive file with parameters passed to the stack-create command via CLI. The parameters required/accepted by this template are:

1. hostname : used to set the hostname configuration on the fortigate itself (optional: defaults to fgt)
2. admintimeout: used to set the admintimeout on the fortigate itself. (optional: defaults to 60)

Instantiation example:

```
heat stack-create –f fgtvm.yml –poll –P “hostname=fgttest;admintimeout=480” test-stack2
```

Steps: Using HEAT to configure FortiGate

This template shows how to configure fortigate via config-drive and to install a license and also to demonstrate passing parameters via heat command line to be interpolated into the config-drive configuration template.

This heat template uses a config-drive file to configure the hostname and admintimeout of a fortigate instance.

They heat template uses the “str_replace” function and “template” parameter. To replace specific text in the config-drive file with parameters passed to the stack-create command via CLI. The parameters required/accepted by this template are:

1. hostname : used to set the hostname configuration on the fortigate itself (optional: defaults to fgt)
2. admintimeout: used to set the admintimeout on the fortigate itself. (optional: defaults to 60)

Instantiation example:

```
heat stack-create –f fgtvm.yml –poll –P
   “hostname=fgttest;admintimeout=480” test-stack2
```

1. Create the required files

Create a config-drive file (fgt.txt) for t

```
config system global
   set hostname $HOSTNAME
   set admintimeout $TIMEOUT
end
```

Create the Heat
template file
(fgtvm.yml).
Add a version and a
description.

```
heat_template_version: 2015-10-15
description: Testing of FOS orchestration
```

2. Set the input parameters

User can input the Hostname and Admin timeout. Template also provides default values.

```
parameters:
  hostname:
    type: string
    label: Hostname
    description: Hostname for instance
    default: fgt
  admintimeout:
    type: string
    label: Admin Timeout
    description:  Session timeout in mins (1-480)
    default: 60
```

3. Define the resources

```
resources:
  fgt:
    type: OS::Nova::Server
    properties:
    image: c21626bc-3a95-45b0-9932-ce4fb4fc90ff
    flavor: custom1
    security_groups: [ default ]
    networks:
    - network: a090ab14-c913-482e-a456-c091a6fdd9f4
    config_drive: True
    user_data:
      str_replace:
        template: { get_file:
                    /home/ftnt/config_drive/fgt.txt }
        params:
          $HOSTNAME: { get_param: hostname }
          $TIMEOUT: { get_param: admintimeout }
    user_data_format: RAW
    personality: {"license": {get_
file:/home/hyyperlite/licenses/vm1.lic}}
```

4. Define the Outputs

```
outputs:
  instance_name:
    description: Name of the instance
    value:  { get_attr: [ fgt, name ] }
  instance_ip:
    description:  IP Address of instance
    value:  {get_attr: [ fgt, first_address ] }
  networks:
    description: IP address of the server
    value: { get_attr: [ fgt , networks,
                    net-10.200.1.0/24, 0 ] }
```

Using Heat to instantiate a FOS-VM

This section describes an example template.

This template is used to instantiate a new FOS-VM, including configuration of the mgmt port, port1 and port2, security groups, floating-ip, disable port-security on specific ports, assign an instance name and assign a FortiManager IP via config-drive.

In this template 3 OS:Neutron:Port ports are created to be used by the FOSVM mgmt, port1 and port2. Port1 and port2 are configured with static IPs and have OpenStack Port-Security disabled so that traffic can be routed through the device from port1 to port2. A floating IP is associated to the fosvm mgmt port also. In this heat template I also create a neutron security-group mgmt-secgroup and assign it to the neutron port that will be used for mgmt interface.

Finally, an instance of type OS:Nova:Server is created. The instance is associated to the 3 ports created above and also uses config-drive to configure the FortiManager IP. However, I use the HOT option “str_replace” & “template” to replace a variable ($FMGIP) in the referenced config drive file with a parameter that I passed in to stack-create with the actual fortimanager IP.

The HOT file includes several defined parameters:

1. fmgip which should contain the FortiManager IP, as I referenced above.
2. mgmt-net network-id to associate mgmt interface to.
3. ixpub-net network-id to associated port1 to
4. ixpri-net the network id to associated port2 to.
5. ftntname name to give to the fosvm instance (this is optional because I defined a default)
6. floatingipid the OS id of the floating ip that I want to assign to the instance.

Instantiation example:

```
heat stack-create –f fosvm.yml --poll –P “fmgip=10.1.1.1; mgmt-net=net-
10.1.1.0/24;ixpub-net=net-172.18.101.0/24;ixpri-net-
t=192.168.100.0/24;ftntname=fosvm-1;floatingipid= 12e03b39-76ed-497d-a7ee-9eca18b-
c2c64”  test-stack1
```

Steps: Using HEAT to instantiate a FOS-VM

1. Set the input parameters

User can input the Hostname and Admin timeout. Template also provides default values.

```
parameters:
  fmgip:
    type: string
    label: FortiManager IP
    description: Set the FortiManager IP for central mangement
    default: 10.46.87.240
  mgmt-net:
    type: string
    label: Management Network
    description: Neutron network id for Managment network
  ixpub-net:
    type: string
    label: IX-Pub Network
    description:  Neutron network id for IX-Pub network
  ixpri-net:
    type: string
    label: IX-Pri Network
    description: Neutron network id for IX-Pri network
  ftntname:
    type: string
    label: Name
    description: fortinet vm instance name
    default: ftnt
  floatingipid:
    type: string
    label: floatingip ID
    description: ID of already created Floating IP
                                    to associate with new instance
```

2. Define the resources

```
resources:
  mgmt-port:
    type: OS::Neutron::Port
    properties:
      network: { get_param: mgmt-net }
      security_groups:
        - { get_resource: mgmt-secgroup }

  ixpub-port:
    type: OS::Neutron::Port
    properties:
      network: { get_param: ixpub-net }
      port_security_enabled: False
      fixed_ips:
        - ip_address: 172.18.101.254

  ixpri-port:
    type: OS::Neutron::Port
    properties:
      network: { get_param: ixpri-net }
      port_security_enabled: False
      fixed_ips:
        - ip_address: 172.18.201.254
```

3. Define the ftnt VM

```
ftntvm:
  type: OS::Nova::Server
  properties:
    image: ccc081d1-26b5-461b-abf0-586a4039b62f
    flavor: m1.small
    name: { get_param: ftntname }
    networks:
    - port: { get_resource: mgmt-port }
    - port: { get_resource: ixpub-port }
    - port: { get_resource: ixpri-port }
    config_drive: True
    user_data:
      str_replace:
      template: { get_file: /home/ftnt/config_drive/fos-fmgip.txt }
      params:
        $FMGIP: { get_param: fmgip }
    user_data_format: RAW
```

4. Define the Floating IP Association

```
association:
  type: OS::Neutron::FloatingIPAssociation
  properties:
    floatingip_id: { get_param: floatingipid }
    port_id: { get_resource: mgmt-port }
```

5. Define the Security Group

```
mgmt-secgroup:
  type: OS::Neutron::SecurityGroup
  properties:
    name: mgmt-secgroup
    rules:
    - protocol: tcp
      remote_ip_prefix: 0.0.0.0/0
      port_range_min: 1
      port_range_max: 65535
      direction: ingress
    - protocol: tcp
      remote_ip_prefix: 0.0.0.0/0
      port_range_min: 1
      port_range_max: 65535
      direction: egress
    - protocol: udp
      remote_ip_prefix: 0.0.0.0/0
      port_range_min: 1
      port_range_max: 65535
      direction: ingress
    - protocol: udp
      remote_ip_prefix: 0.0.0.0/0
      port_range_min: 1
      port_range_max: 65535
      direction: egress
    - protocol: icmp
      remote_ip_prefix: 0.0.0.0/0
      direction: ingress
    - protocol: icmp
      remote_ip_prefix: 0.0.0.0/0
      direction: egress
```

6. Define the Outputs

```
outputs:
  instance_name:
    description: Name of the instance
    value:  { get_attr: [ ftntvm, name ] }
  instance_ip:
    description:  IP Address of instance
    value:  {get_attr: [ ftntvm, first_address ] }
```